

# Mount John University Observatory



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## Foreword

The Mount John Observatory is operated jointly by the Universities of Pennsylvania and Canterbury. It is the desire of both Universities that the functions of the Observatory and its work should become well known to the public. The aim of this booklet is to provide this information and, at the same time, to give simple answers to some of the questions which visitors to the Observatory so frequently ask the astronomers.

Since the interest that is taken in the Observatory is nation wide and, in fact, stretches far beyond the shores of New Zealand, the booklet also provides some details of the surrounding country, with its magnificent scenic resources. A summary of the facilities available for visitors to the district is also given.

The intense interest that today, is taken in the heavens, comes partly from man's first voyaging into space as well as from a natural curiosity concerning the celestial bodies.

Nothing can be built without the assistance of many people. The site testing survey, which lead to the establishment of the Mount John University Observatory, was only possible because of the co-operation and practical help from the public in every part of the country. To build the Observatory to the full standard of a modern astronomical observatory, and, at the same time to cater for the public requires the provision of many facilities and the expenditure of large sums of money. Within this booklet can be found suggestions as to how all who are interested can assist especially in providing facilities which cannot be secured from Government or University sources.

The booklet itself is an attempt to assist the general building fund of the Observatory and all the profits will be devoted to that purpose. For making the booklet possible the Observatory is indebted to the advertisers for their support. This support has been freely given in the firm belief that they are not only assisting themselves by purchasing space that will increase their profits, but also convinced that at Mount John there is gradually being built, an institution of value to the entire country, not only scientifically and culturally, but also an economic asset of enormous benefit to the district and the visitors it serves.

May we have your assistance by purchasing one or more of these booklets and by telling your friends where they can be obtained? By so doing you will assist the Observatory to provide added facilities which will make your visits to Mount John so much more instructive and enjoyable.

# Why Study Astronomy?

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Astronomy is the oldest of the sciences. Probably its ancestor was magic, called on at a distant past age to explain natural phenomena then attributed to gods who were feared and had to be appeased. At a very early stage in his development man learnt that the natural phenomena seen in the heavens were of use to him and could be explained. Many events he found to be predictable.

A permanent calendar was marked out in the sky by the rising and setting of certain stars and constellations. From noting these man knew when to plant and harvest his crops. He found that the rotation of the Earth caused night and day, whilst its annual revolution around the Sun resulted in the seasons. Use was made of the Moon's revolution around the Earth to divide the year into months.

As civilisation grew and became more complex mankind had to devise methods of keeping time accurately; of navigating to distant countries and of fixing the boundaries of areas of land. Astronomy, by this time a science, provided answers to all these problems. Remote as astronomy may appear from every day life, it still provides the methods by which these essential services are provided. Without such services everyday life would be complete chaos.

Astronomy first revealed to mankind natural laws. Its growth has steadily broadened our horizons. Naturally early man regarded the Earth as the centre of the Universe. Then it was found that our globe was but one of a number that circled the Sun, which, as a result, displaced the Earth as the centre of the universe. Later still it was found that the Sun was but one of a vast array of stars forming the galaxy to which we belong. Thus, in turn, the Sun was displaced as the centre of the universe. Then it was found that this galaxy is but one of millions that populate the known universe. Thus astronomy has taught us both the significance and the insignificance of mankind.

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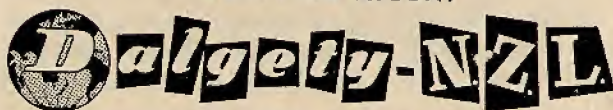
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Today astronomy is at the very apex rising from the broad base of science. As an example, it is very closely related to physics and to the whole broad area of the physical sciences. Thus high-calibre astronomical research stimulates developments in the related physical sciences.

It was from observations of the motions of the planets that Newton discovered the laws of motion and gravitation. These form the very basis of modern technology. The science of optics was first developed for astronomical purposes. This led, not only to the invention of the astronomical telescope, but also to the microscope, which has become of such importance to medicine and in other fields totally unrelated to astronomy. Many of the mathematical tools in everyday use by engineers were first developed to solve astronomical problems.

Spectroscopy had an astronomical origin. Indeed it is still one of the astronomer's most useful tools. But it has been developed so that it bears directly on everyday life, through its application to physics, chemistry, biology and many other regions of knowledge. Nuclear physics has a very close association with astronomy since astronomers observe the interactions between atomic nuclei under conditions that often cannot be equalled in the laboratory.

Astronomy is an application of the scientific method, whose logic has proved the most valuable means in the physical and intellectual emancipation of mankind. The sheer beauty and wonder of the heavens has attracted universal appreciation for centuries.

This, combined with its ability to stimulate intellectual curiosity, is the attraction of astronomy to the average person. No one can contemplate the heavens but feel humble. He is awed by the beauty of other worlds and eager to learn something about them.

Whilst some of the benefits derived from astronomy have been mentioned, it has been truly stated by Willem de Sitter that, "All great technical advances have been based on scientific discoveries which at the time appeared to be utterly useless, and were made by men who studied science for its own sake." Real progress in human affairs is impossible without such pure scientific research. That is precisely the purpose of the Mount John University Observatory.

# The Mount John University Observatory

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Mount John is an isolated peak rising sharply one thousand feet above the western shores of Lake Tekapo, in the Mackenzie Country of South Canterbury. On its summit, 3,377 feet above sea level, the Universities of Pennsylvania and Canterbury jointly operate the Mount John University Observatory.

## WHY MOUNT JOHN?

Astronomy is a big science and the tools used by astronomers are expensive. It is therefore, uneconomic to place their telescopes in unsuitable locations. To operate the instruments at the maximum efficiency astronomers desire to have sites that provide them with the greatest possible hours of clear sky and which, at the same time, produce conditions of a stable atmosphere. Turbulence in the air distorts the images of the stars and planets when viewed through telescopes so that it becomes difficult or impossible to measure or analyze the messages of light that reach us from these distant objects. For these reasons it is also necessary to seek sites that are as free as possible from haze, fog, artificial lights and dust. Low relative humidities and a small range of temperatures are needed to prevent distortion of the delicate optical surfaces in telescopes.

Thus astronomers avoid cities and coastal plains. They seek their sites in remote country districts and prefer mountain tops to get above much of the disturbances in the lower atmosphere. Whilst conditions, when they are clear, would be extremely good on say the summit of Mount Cook, the problems of working and living under the weather that prevails would be impossible, whilst the logistic problems of communication, roading, power and water supplies would be well nigh insurmountable. So in considering a site for an astronomical observatory many factors have to be considered.

When it was first proposed to establish an observatory in New Zealand, it had to be shown that the country could offer at least one site which would provide suitable conditions. To enable an investigation to be made the National Science Foundation of

Washington provided the finance for a survey of the country. The research was directed and led by the present Astronomer in Charge of Mount John, Frank M. Bateson. Under him there were 13 young men who revealed the highest qualities of courage and devotion to science in living under the most rugged conditions on lonely mountain tops.

Following a preliminary survey of all districts within New Zealand likely to have a suitable site, it was possible to select those places which appeared the most suitable and, from which it was possible to keep a watch over surrounding ranges. A base station was established on Black Birch Range in Marlborough at an altitude of 4,600 feet. Here the observers were trained before being sent out to the network of testing stations established. Since nothing was known of conditions on the high country as far as they concerned astronomical factors, it was necessary to man Black Birch throughout the  $2\frac{1}{2}$  years of research. Thus measurements were obtained by which the relative value of other sites could be gauged.

The North Island was soon ruled out since suitable peaks were in the wrong places and were too exposed to the westerly weather resulting in unsuitable skies. In the South Island testing stations were erected in Nelson, at Mount Malita; in South Canterbury at Mount John and in Central Otago at Mannorburn in addition to the main station at Black Birch. Many other sites in each district were tested. In each district the testing station and the living quarters for the observers came largely from volunteer assistance within the district. At Black Birch a power line to 4,600 feet and a formed road were provided solely through the efforts of local residents in the desire to assist and in the hope that their district might secure the final establishment.

The scientific facts resulting from the numerous measurements of all relative data have been set out in the Final Report on the Site Selection Survey of New Zealand, printed as Volume X of the Astronomical Series in the Publications of the University of Pennsylvania. These made it clear that the final choice lay between Black Birch and Mount John. Mount John was recommended by the Chief Investigator because it had clearer night skies, lower rainfall, drier air, lower wind strengths and much less fog as well as a marked seasonal trend which provided very much better seeing conditions and freedom from turbulence in autumn and winter, when the nights are longest. In addition, it was further south permitting the celestial objects in the southern sky to be observed from higher altitudes.

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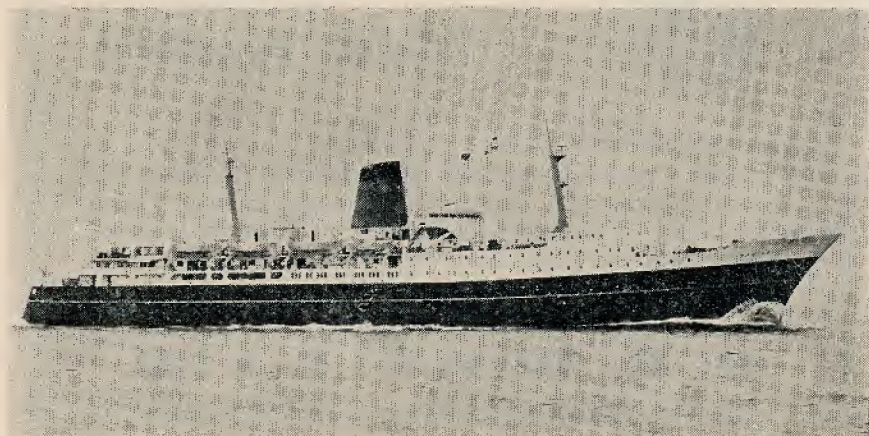
Both Universities accepted the recommendation arising from the site survey. On 29th July, 1963 the official announcement of the chosen site was made together with the details of the agreement between the Universities of Pennsylvania and Canterbury to jointly operate the new Observatory. Sufficient land for the purpose of the observatory and for the access road to the site was most generously made available from their crown lease by Messrs R. G. and H. Hunter Weston.

The University of Canterbury received a grant of £30,000 from the Scientific Research Committee of the Golden Kiwi Lottery. This permitted the commencement of building in late October, 1963, by providing the facilities of roading, power and water as well as the telephone line. In addition it was possible to construct quarters for visiting astronomers and observers, as well as for the resident astronomer. One telescope was already in place on the mountain, the 8-inch refractor owned by F. M. Bateson and which was used in the final stages of testing. The building that houses this instrument was erected through the volunteer services of the members of the Round Table organisation from Timaru and Ashburton.

The University of Pennsylvania provided an astrographic telescope—an instrument specially designed for photographic work—together with the funds for its building. The darkroom for use in conjunction with the instrument was partly provided by Pennsylvania but mainly through the Observatory undertaking to develop films from seismographs installed by the Geophysics Division of the Department of Scientific and Industrial Research. A small grant was provided by Pennsylvania, which with money and material from N.Z. enabled the 16-inch reflector lent by F. M. Bateson to be housed. The National Science Foundation has recently made a grant to support photographic researches in conjunction with the Bamberg Observatory, who have provided the cameras necessary. This grant will permit the building, darkroom and mounting for these cameras to be constructed before October, 1966.

The foregoing provide the present instrumentation with which research is possible and by the use of which the University of Canterbury have available the means of providing practical instruction to students. Mount John will become one of the major centres for astronomical research by the two Universities involved and it is hoped that the range of instruments available will steadily be extended.

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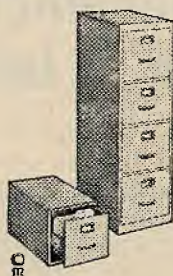
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# A Scale of the Universe

Astronomy deals with vast distances. So great are these that mention of them conveys little real meaning. An appreciation of the relative sizes and distances is best obtained from models. We will construct one first of the Solar System and then of the known Universe.

The Sun, 864,950 miles in diameter, can be represented by a globe 2 feet in diameter. At 83 feet from this globe a medium sized pinhead will represent Mercury, the nearest planet to the Sun. Moving away from the Sun the next planet is Venus, which can be depicted by a small pea 156 feet from the central globe. A slightly larger pea will represent the Earth and will be placed 215 feet from the globe representing the Sun. Mars will be a large pinhead 109 yards from the central globe. The largest of all the planets, Jupiter, will appear on this model as an average sized orange some 373 yards from the centre. A large plum will stand for the ringed planet Saturn and will lie two-fifths of a mile from the centre. A further two-fifths of a mile will bring us to a large cherry representing Uranus. The outermost planets, Neptune and Pluto, can be depicted by a plum and a small pea respectively placed at distances of 1.2 miles and 1.6 miles from the central globe.

If the globe representing the Sun was placed on the top of the Timaru Post Office the nearest star could be represented by another two foot globe placed in the heart of London. Like space itself, the regions between our various models of the planets would be largely empty.

To include the more distant stars the model has to be considerably compressed. If a single grain of sand is placed on top of the Timaru Post Office it will represent the entire Solar System. The nearest star will be also a grain of sand 18 inches away. Most of the stars visible to the unaided eye would lie within a few yards of the centre of this model. Scattered grains of sand within a radius of 30 miles would represent all the stars of our own galaxy, or star city.

The nearest galaxies to our own are the Magellanic Clouds which could be placed in Christchurch and Dunedin. Since our part of the universe is rather crowded, the next nearest group of galaxies would have to be placed some 3,000 miles from Timaru. Galaxies even further away would, on this scale, be placed around London. But even then the most remote galaxies known would on this scale be at approximately the distance of the Moon—some 240,000 miles away.

In recent years astronomers have discovered objects, known as quasars, which are more luminous than 100 million million stars like our Sun. The light received from them commenced its journey so long ago that it has been travelling for three times longer than the Solar System has existed. On our model they would have to be placed at a distance of 300,000 miles from the centre.

# What is "A Shooting Star"?

Often, whilst gazing at the night sky, we see a sudden short flash of light dart across the sky. We then say we have seen a "shooting" or "falling" star. There is really no connection with the stars.

What has happened is that a small, solid particle has entered the earth's atmosphere. As a result of the friction with the atmosphere the particle has rapidly vaporised. This friction is a natural result of the speed of many miles per second at which the particle is travelling. The luminous spot of light that results is what we see as it rapidly moves through the atmosphere. These objects are called meteors. Some 24 million meteors, bright enough to be visible to the naked eye enter the atmosphere every day. The atmosphere acts as a protective blanket saving us from a continual celestial bombardment since the meteors are completely burnt out far above our heads. Even the brightest of them rarely descend lower than 30 miles above the Earth's surface.

When a meteor is burnt out minute particles of dust remain. These gradually descend through the atmosphere to the surface. As a result roughly 2,000 tons of such dust is deposited on the Earth each year. That sounds like a lot of dust but this quantity is spread over the entire globe, including the oceans. If the rate of falling dust remained constant at this quantity each year the resulting layer would cover the Earth in a uniform depth of one fifth of an inch in 3,000 million years.

Many of the particles we eventually see as meteors are travelling around the Sun in swarms, in which each particle is widely separated from its neighbour. When the Earth crosses one of these swarms more meteors than usual are visible. Such displays are called showers of meteors. Since the separate particles are travelling in parallel paths the resultant meteors appear to radiate from some particular spot in the sky. It is very much like looking along the parallel tracks of a railroad. They appear to diverge from a point in the distance. Some of these meteor showers are from particles left by comets and travel in much the same orbits as their parent comets.

Most of the particles are no larger than a grain of sand. Occasionally a very much larger body is encountered which is not completely vaporised in its passage through the atmosphere. These fall on the Earth and are known as meteorites. About 1,400 have been found and these represent the only solid matter from outer space that astronomers have been able to handle. For the rest of his knowledge of the heavens the astronomer is dependent on his analysis of the waves of light and energy emitted by the stars.

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# — Our Sun —

## The Nearest Star

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The Sun, at its equator, has a diameter of 864,950 miles, just over 109 times the diameter of the Earth. Its mass is 333,000 times that of the Earth and its volume over a million times greater. Its density, however, is only a quarter that of the Earth. At the surface of the Sun the temperature is roughly  $6,000^{\circ}\text{C}$  whilst in its interior it has been calculated that the temperature is around 20 million degrees.

Despite these huge figures the Sun is really a very ordinary star, neither very hot nor very cold; neither very large or very small. It is, of course, entirely gaseous. All life on the Earth is entirely dependent on the energy radiated in various forms by the Sun.

When photographed the surface of the Sun shows a grain like structure in which the pattern changes in a few minutes, reflecting the continually active motions in this seething mass of gas. This surface pattern, termed "rice grains" is entirely irregular and each grain may be several hundred miles across.

Usually dotted over the face of the Sun are dark spots, termed sunspots. They appear dark only by comparison with the surrounding visible disk of the Sun known as the photosphere, meaning sphere of light. The sunspots are at a high temperature but around 1,500 degrees cooler than the photosphere. They range in size from minute areas just large enough to be seen to vast spots covering areas of a hundred thousand miles or more.

Some sunspots last only for a few hours; others for several days and a few have remained for several weeks. Occasionally there occurs a long enduring spot that will last for months. From study of the motions of these spots it was found that the Sun rotates in just over 25 days. It was also found that the number of spots vary over a period that averages 11 years. At the start of a new cycle sunspots begin to make their appearance far from the solar equator. As the cycle proceeds the general location of

the sunspots shifts closer to the equator and they increase in numbers and size. When maximum activity occurs some of the spots cover enormous areas. After the maximum phase has passed sunspot activity gradually dies away and by the time the first spots of the next cycle appear there still remain, close to the equator, some small spots of the previous cycle.

Other solar activity is associated with sunspots. Near them are found large mottlings on the surface, known as faculae. These are thought to be temporary mountains of gas whereas the sunspots are regions of low pressure. As the hot gas flows into these regions it expands and cools thus accounting for the dark appearance of the spots, or storm centres on the Sun.

The turbulent state of the solar atmosphere results in vast eruptions of gas having the appearance of huge flames. These are called prominences. Some are truly eruptive, their material being shot upwards with terrific force; others appear suspended in space whilst still others appear to form above the Sun without cause and then rain material down on the Sun. The material of the eruptive prominences is shot outwards with speeds of around 120 miles per second, although unusual outbursts have attained speeds of 600 miles per second. Prominences occur in the lower portion of the solar atmosphere, just above the photosphere. This is called the cromosphere because of its general pinkish colour due to hydrogen. Above this again is the outer atmosphere of the Sun, known as the corona. Normally the feeble radiation from the corona is hidden by the bright glare of the Sun. But during a total solar eclipse the corona becomes visible as a delicate pearly white halo surrounding the Sun with a complex structure of delicate streamers fanning outwards. These coronal streamers often extend for millions of miles into space, but their form varies with the 11 year sunspot cycle.

Associated with the chromosphere are the solar flares, sudden, short lived but very intense brightening of an area near a sunspot. These flares are often the cause of the fadeouts in short wave radio transmission on the Earth.

These are only some of the many wonders that the Sun shows us. The study of the Sun at the great solar observatories has many practical applications to every day life by improving our knowledge of the behaviour of the atmosphere of the Earth, in improving knowledge of the weather cycles, magnetic activity and radio communication.

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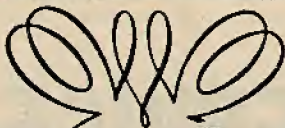
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# The Mackenzie Country

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Back in 1855 James Mackenzie discovered it was possible to drive sheep across passes, then known only to the Maoris, and feed them on the tussock, wind swept uplands beyond. From this upland he knew, too, of passes that lead into Otago where sheep could be sold at a good profit. The only trouble was that the sheep were not his own and soon after his arrest he was sentenced to goal for sheep stealing but was subsequently pardoned. His name was bestowed on the country and behind him has accumulated a host of tales; some fanciful, some true.

Long before Mackenzie, the Maoris knew of and visited this inland plateau, especially in summer. Judging too, from the remains that have been found the giant moas once ranged its pastures.

To visit the Mackenzie Country is like entering another world. From the northern outskirts of Timaru, at Washdyke, a road leads off inland aimed directly at the snow capped mountains shimmering in the distance. For thirty eight miles the sealed roadway snakes and twists in easy meandering bends following much of the old coaching road to Fairlie. Alongside runs the branch railroad from Timaru. Thrice weekly the "Fairlie Flyer" puffs and pants its way from Timaru to Fairlie and back carrying the fertiliser and supplies for the rich farmlands and bringing back the produce they grow. Rail and road play hide and seek with one another; first close together, then changing sides, then each wandering off on their own only to cross tracks every now and again as if frightful of losing their companion. The rail terminates at Fairlie, but the road continues to twist and turn through the ever narrowing valley, alongside a babbling brook and golden thickets of broom. Eventually it finds a way over the mountains at Burkes Pass.

A short, steep climb and the summit of the pass is reached. Reached too, is a different world, which only attains its full glory after a short run down the eastern slope of the pass to Haldon's Corner. Here the road bends north west towards the heart of the mountains. But before travelling on, pause awhile. Barren, desolate and arid are the first terms that one thinks of to describe

the vista. But looking closer one sees a stark beauty as the golden tussock wave and bend before the breeze with a constantly changing pattern of light and shade. Relieving the barren landscape here and there stand the dark green of trees. Plantations that have withstood the hot summers, the bitter frosts of winter and the parched soil. They are as necessary for survival as water, for they provide the shelter from the howling, shrieking spring gales that sweep down from the mountains.

It is not for long that one dwells on the aspect of this rough, glacier hewn plateau. Irresistibly one's gaze is drawn to the range upon range of mountains rimming this high inland country in every direction. Here and there a low saddle shows that it is possible to cross these mountains. Away to the south the glinting blue of the Tekapo River traces its meandering course to join the Pukaki and Ohau, whose combined forces have gouged a channel through the mountain barrier.

Each day, each season shows some fresh play of light and shade upon the jagged peaks rising in tier upon tier till they seem to pierce the very sky. In winter they are softly clothed in glistening snow, which turns to gold and scarlet at sunrise and sunset. The snow hides the forbidding challenge of hundreds of rugged peaks, sufficient to last a mountaineer a life time.

Summer sees the snows recede until only the higher levels are draped in the purest white, dazzling in the sunshine. The rest stand stark and sheer sculptured into a thousand fantastic shapes by the gigantic forces of nature. Here is an open picture book for all to read of how nature first thrusts up the mountains and carves out the valleys, only to then slowly and relentlessly grind them down again.

Having paused awhile, move on but stop again before descending a short incline to Tekapo. Before you stretch the deep blue waters of Lake Tekapo, a perfect mirror for the azure sky overhead in which too are cast the clean, clear reflections of the snow covered mountains. And across the lake rises the slopes of Mount John, now crowned by the domes of the instruments that probe and seek the answers to the riddles of the Universe. Here as the stars fade in the approaching dawn, the astronomers too, catch the magic of this majestic land. First a rosy glow on the very summit of Mount Cook, whilst all else is in darkness. Then the rosy glow spreads to lesser peaks and finally the Sun rises in a sky of azure blue. A fitting place for an Observatory.

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# The Village of Lake Tekapo

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Clustered around the southern end of Lake Tekapo and nestling against the south eastern face of Mount John are the houses and cottages of the village of Lake Tekapo. It is an ideal winter and summer resort for, within easy reach, are facilities to cater for all tastes. In winter a short, pleasant walk along the tree fringed shores of beautiful Lake Tekapo brings the visitor to the outdoor skating rinks. Thanks to the shade provided by Mount John here can be enjoyed the longest outdoor skating season in the country. An hour's drive along the eastern shores of the lake brings one to the fine ski-ing grounds, with snowy slopes, that test the skill of the professional and provide easy runs for the beginner.

In the summer excellent trout fishing is available on Lakes Alexandrina, McGregor and Tekapo. Despite the cold waters of the glacier fed Lake Tekapo, there is a sheltered bay with smooth water for boating and water ski-ing. The surrounding district presents many challenges for those who prefer to tramp or hunt. But most visitors prefer to relax in the clear, fresh air of this high inland country and soak up the warm sunshine that makes it a favourite resort for those who thrive in the sun, no matter what time of the year it may be.

Tekapo makes an ideal base from which the visitor can visit Mount Cook, Lakes Pukaki, Ohau and Benmore. He can bask in the brilliant sunshine and select days for his trips elsewhere when the weather at those places is clear without having the annoyance of visiting them only to find that he cannot see anything for cloud or rain.

For those who wish to travel further afield—to Queenstown, Central Otago, the Haast Pass and West Coast—Tekapo is also an ideal spot, at which to rest for a day or so.

Although small, the village caters for visitors with a wide range of facilities, ample for all needs. One is certain of a warm welcome at the Lake Tekapo Hotel, presided over by the genial

Bill Crossman and his charming wife. There is no need to fear the hard frosts that follow the days of brilliant sunshine, for all rooms have heating and all beds are supplied with electric mattresses. Each room has its own private bath. From the lounge windows one gazes across the deep blue waters of Lake Tekapo to the far off mountains.

Should the visitor prefer to cater for himself there is the very modern Lake Tekapo Motel, in which each of the nine units comprises two bedrooms together with a spacious lounge. A fully equipped all-electric kitchen with each unit enables visitors to prepare their own meals at whatever hour takes their fancy. Should they prefer to dine out then the attached dining room, opening shortly, will cater for their meals.

For those who prefer to be completely free there are available four self-contained holiday cottages in the Lake Tekapo Domain. Reservations should be made well ahead with the Resident Caretaker. Charges range from £1/12/6 per night to £10 per week for a cottage. Visitors must supply their own linen, blankets and cutlery.

If a visitor is travelling with a caravan, or prefers to camp, the Lake Tekapo Domain has a fine camping ground nestling amidst the trees at the base of Mount John. Power is available, as well as toilet facilities, showers and laundry. The charges are only 7/6 per night or £2 per week.

Should your car need attention adequate repair facilities are to be found at the fully equipped Tekapo Garage. All supplies to cater for the hearty appetites that develop in this salubrious climate can be purchased from the well stocked Tekapo Store.

Visitors will, of course, wish to visit the Mount John University Observatory, not only to inspect the observatory and to learn something of astronomy, but also to enjoy the magnificent view of the surrounding lakes and mountains. It is desirable to make a booking for such a visit in advance by writing or ringing the Astronomer in Charge. Visitors are welcome at the Observatory during afternoons from 2 to 4.30 p.m., but with the large number of organised parties visiting the Observatory and other duties it is not always possible to arrange a visit at short notice. In addition, as the access road passes through farmland, it is necessary to keep the gate locked at all times. Arrangements therefore have to be made for a key to permit visitors to enter.

# Lake Tekapo Hotel

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## Gateway to the Mackenzie Country

Some 38 miles inland from Timaru is Fairlie, the administrative centre and principal town serving the Mackenzie Country. Here are the offices of the Mackenzie County Council, which controls the 2,852 square miles that form the county. Here too, terminates the branch railway running from Timaru.

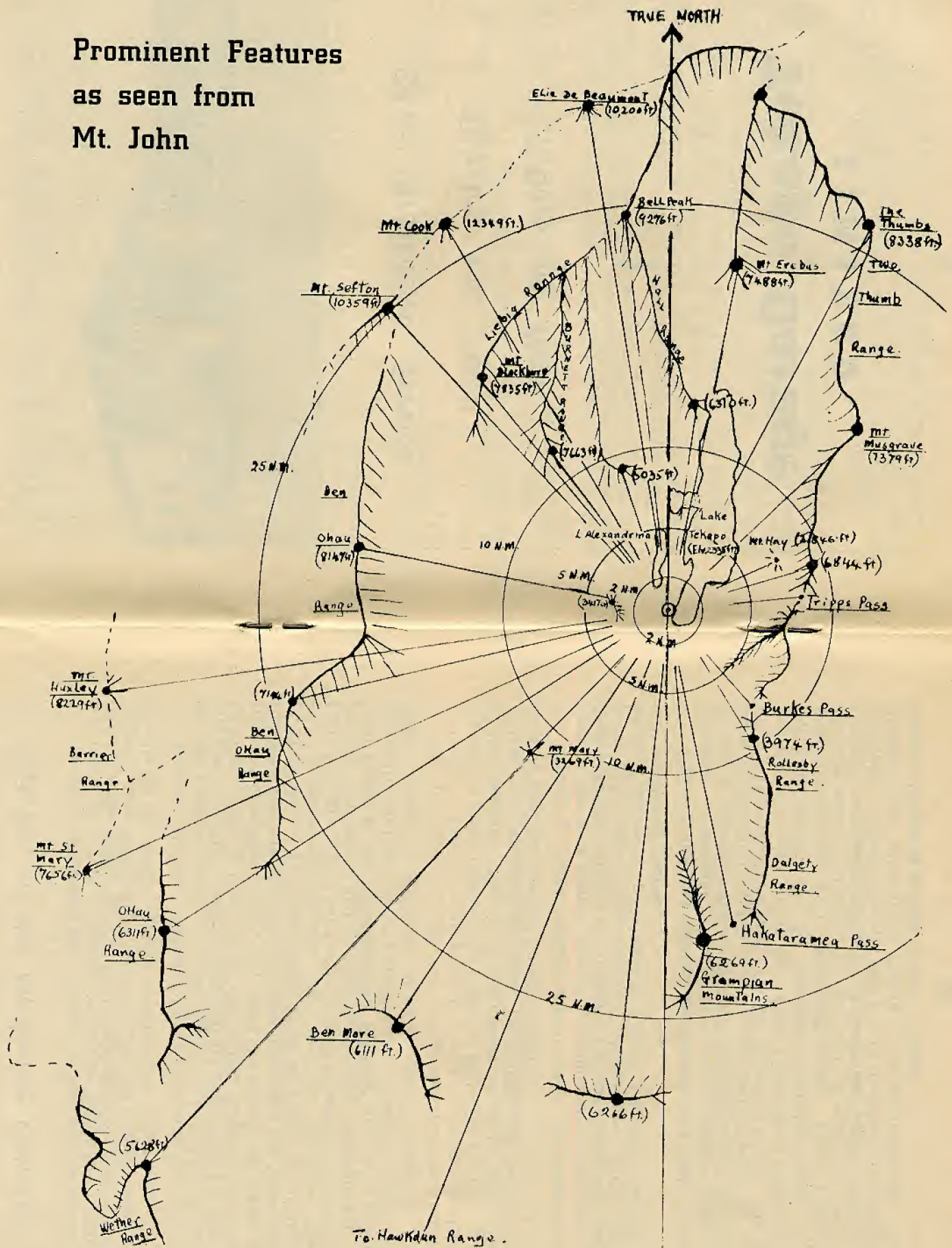
Fairlie is the true "Gateway to the Mackenzie Country" for its well equipped shops serve the needs of the scattered farms and stations of this region. The District High School is located in Fairlie. For a town of its size Fairlie boasts a very wide range of amenities. Here, too, dwell the men in all trades and the firms that employ them and who have built the Observatory at Mount John. The Observatory draws on Fairlie for almost all of its building requirements. As a result of this close contact, there has grown up a bond of friendship between this close-knit, friendly community and the astronomers on the mountain. A bond forged in the knowledge that together they were building an institution that will be a credit to the district in which they dwell.

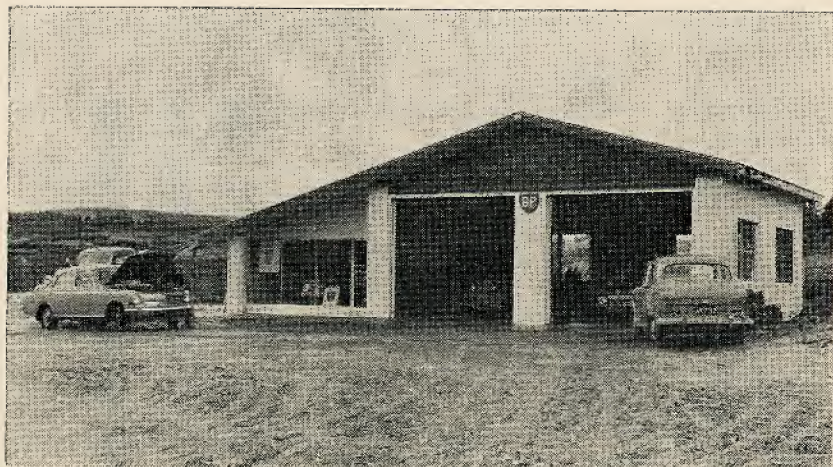
The port and principal city serving the Mackenzie Country is Timaru. Entirely man made this port has regular shipping services to many parts of the world, as well as to the main ports of New Zealand. The city is adequately served by other means of transport—air, rail and road. It provides the business and banking facilities used by the Observatory.

Timaru is a most popular holiday resort. Its citizens have time to live at a slower pace that permits the development of their particular hobbies and pursuits. The numerous clubs testify to the wide range of these interests. Boasting one of the highest levels of prosperity in the country, Timaru is a solid, conservative city of friendly people.

Whilst inland and isolated, the Mackenzie Country is easy of access. A pleasant  $1\frac{1}{2}$  hours drive on a tar sealed highway is all that is necessary to reach Tekapo from Timaru. The distance from Christchurch is 165 miles, a very comfortable  $3\frac{1}{2}$  hours drive. The motorist has the choice of several routes. He may find the trip south on the rim of the Canterbury Plains boring and uninteresting but the constantly changing vistas of the western mountains will relieve the monotony. Then, rather than continue south to Timaru, he can turn off and take the route through the pleasant rolling country surrounding the township of Geraldine. This in turn will lead him to the hills overlooking the pleasant, rich valley at the foot of which nestles Fairlie. From here to Tekapo is a short trip of 27 miles.

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# The Five Brightest Planets

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## MERCURY

This planet is nearest to the Sun. Apparently it rotates on its axis in the same period as it revolves around the Sun—88 days. Because of this the same side is always in sunlight and here the temperature is probably around  $700^{\circ}$  F, sufficiently hot to melt lead. The dark side is so cold that no measurable heat has been detected and it is probably colder than minus  $400^{\circ}$  F.

Vague markings have been seen on the surface of Mercury but it is a disappointing object in a telescope. No atmosphere has been detected, nor would one be expected since the small size of this planet would not enable it to retain the gases to form an atmosphere.

## VENUS

Planets have no light of their own and only reflect the sunlight that falls upon them. Venus has the highest reflective power of all the planets and hence appears the brightest. It does not differ much from the Earth in size or density. Thus it is thought to have a similar internal structure.

Venus is shrouded in dense cloud layers which prevent us from seeing its surface. Measurements of this cloud layer indicate that it is cold by earthly standards, but radio measurements show that deep in the interior of the atmosphere very much higher temperatures exist. Carbon dioxide appears to be plentiful and a small amount of water vapour has been detected.

The most striking feature of Venus, like Mercury, when seen through a telescope is its change of phase and apparent diameter. These are due to the changing relative positions of the planet with respect to the Earth and the Sun. Venus is at greatest brilliancy thirty-six days before and after inferior conjunction. The planet then appears crescent shaped, like the young Moon. Before this phase, when the planet is a very slender crescent, thin bright arcs extend from the crescent right around the planet to produce an appearance similar to "the young Moon in the old Moon's arms."

Because there are no really definite markings to be seen, the rotation period of the planet is subject to some doubt. The latest radar observations indicate that Venus rotates in a retrograde direction in a period of 244 days.

## MARS

Mars, more than any other planet, has intrigued the layman because it has so often been depicted as the abode of intelligent life in the fantasies of the fiction writers. This originally came about through the discovery in 1877 by Schiaparelli of many fine lines crossing the surface of Mars. These he called "canali", an Italian word for "channels." Unfortunately this was translated as "canals", which was immediately taken as implying that they were of artificial construction.

The most conspicuous feature of Mars is whichever polar cap is presented to our view. These caps form in the Martian winter and shrink in the summer. Each shrinking polar cap is bordered by a dark blue belt, that retreats with it, suggesting that the caps are composed of water. It is more likely that they are ice, or hoar frost and change directly into gas without becoming liquid. This process is called sublimation and would be possible with the very low atmospheric pressure on Mars.

Apart from the polar caps, the most notable feature of the Martian surface is the reddish-ochre colour of three-fifths of the globe. Darker areas are found to present a permanent form and these under the best seeing conditions appear a dark green. A more or less systematic change has been detected in the colour of these areas suggestive of the changes that would occur in vegetation with the progress of the seasons.

That Mars has an atmosphere is apparent from the clouds, which, on occasions, have been seen. These clouds appear to be of two types. White clouds, somewhat similar to our own cirrus clouds, and yellow clouds, probably due to dust. Such dust would be raised either by the Martian winds, or possibly, even by particularly strong solar winds sweeping the eroded and arid landscape of the planet.

## JUPITER

So large is Jupiter that it contains more material than all the other planets combined. Its diameter is 11 times that of the Earth. It takes 12 years to revolve around the Sun and is accompanied by 12 moons.

Two hydrogen compounds, ammonia and methane, make up the bulk of Jupiter's atmosphere. It is certain that the atmosphere is mainly hydrogen because the density of the planet is

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only 1.3 times that of water. No other known substance could explain such a density. Some two hundred miles below the surface of the visible clouds the weight of the gases above must produce a layer of liquified gases. Lower still this liquid must harden to a solid.

When seen with even a small telescope Jupiter reveals alternative light and dark bands, lying parallel to its equator. On these, from time to time, appear many bright and dark spots. Observations of such spots have shown that the planet rotates at different speeds in different latitudes. At the equator this rotation is 9 hours 50 minutes, whilst for most other regions it is five minutes longer, which means the planet rotates in these parts with a speed of 200 miles per hour less than at the equator. The equatorial speed of rotation is 28,000 miles per hour and this rapid rotation makes the planet bulge at the equator so the diameter there is 6,000 miles greater than at the poles. The rapid changes in the spots indicate that the atmosphere is in a state of continual change.

## SATURN

Saturn is  $9\frac{1}{2}$  times as far from the Sun as the Earth; its mean diameter is  $9\frac{1}{2}$  times that of the Earth whilst its mass is 95 times the Earth's. Coupled with the fact that its volume is 750 times the Earth's its mass is such that the density is only  $\frac{1}{8}$  ours. Thus it is only 0.7 times as dense as water and the least dense of all the planets.

Of all the celestial objects, Saturn is the one that impresses most people. Its disk is crossed by alternate bands of light and shade like Jupiter but less distinct. However, surrounding the planet are three concentric shining rings lying in the plane of the planet's equator. These rings are composed of thousands of very small particles revolving around the planet, with the innermost travelling the fastest. Whilst hundreds of miles across the rings are not very thick. Because of the changing relative positions of Saturn, the Sun and the Earth the appearance of the rings change. At times they are seen wide open surrounding the planet, whilst at other times, such as in 1966, they are only visible as a very thin line on either side of the planet. At such times they become invisible in small telescopes.

Saturn is also accompanied by nine moons, one of which Titan, is 2,980 miles in diameter and the second largest satellite in the Solar System.

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# How To Find The Bright Planets

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The five bright planets are fairly easy for even the casual observer to locate, provided he knows roughly where to look and uses their brightness as a guide. Venus is usually bright enough to far outshine any other heavenly body except the Sun and Moon. It can even be seen in broad daylight especially when it is near the Moon. Mercury, Mars and Saturn are always of first magnitude, appearing as the same brightness as all but the very brightest of the stars. Jupiter normally is brighter than even Sirius, the brightest star.

The following general guide can be used by observers in New Zealand to identify these planets up to the end of 1967. More detailed information is included in the lists of astronomical phenomena on pages 38 and 40 for 1966 and on pages 43 and 44 for 1967.

## MERCURY

Being much closer to the Sun than the Earth this planet is never far from the Sun. It makes alternatively brief appearances in the evening and morning sky. Not all such appearances are favourable for viewing, since Mercury has an eccentric orbit so that at times it is too close to the Sun to be visible after evening twilight or before dawn. The best times to see the planet are for a week on either side of the following dates:

In the evening sky: 1966, October 26; 1967, October 10.

In the morning sky: 1967, March 31.

## VENUS

There is little difficulty in picking out Venus because of its great brilliancy. Being closer to the Sun than the Earth it is never visible in the midnight sky but gets further away from the Sun than Mercury. As an evening star Venus will be best seen from 1967, March 20 to July 20 and as a morning star from 1967, September 15 to December 31.

## MARS

Mars will be in the following constellations:

1966 July 10	to Aug. 19	Gemini
Aug. 20	Sept. 22	Cancer
Sept. 22	Nov. 21	Leo
Nov. 22	1967 Aug. 4	Virgo
1967 Aug. 5	Sept. 9	Libra
Sept. 10	Sept. 20	Scorpius
Sept. 21	Oct. 15	Ophiuchus
Oct. 16	Nov. 28	Sagittarius
Nov. 29	onwards	Capricornus

This planet reaches opposition on 1967, April 16, when it will be rising at sunset and setting near sunrise. It is then best seen, being at its brightest and at the highest point in the path across the sky at midnight. At 7 p.m. on April 23, 1967, it will be very close to Spica, the brightest star in the constellation Virgo.

## JUPITER

Throughout 1966 and 1967 this planet will be far north of the celestial equator. As a result it will cross the meridian well north of the zenith. It reaches opposition on January 20, 1967. Jupiter will be in the following constellations:

1966 May 1	to 1966 Sept. 7	Gemini
Sept. 8	1967 Feb. 9	Cancer
1967 Feb. 10	April 30	Gemini
May 1	Aug. 14	Cancer
Aug. 15	onwards	Leo

## SATURN

Saturn reaches opposition on 1966, September 19 and again on 1967, October 3. Throughout the next 18 months it can be found in the small northern constellation Pisces. It will far outshine all the stars in that constellation.

It will be well worth rising early on the morning of June 3, 1967, when at 5 a.m. the Moon will pass in front of Saturn thus occultating the planet.

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# Astronomical Phenomena

## For 1966

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### PHASES OF THE MOON

New Moon			First Quarter			Full Moon			Last Quarter		
	d	h		d	h		d	h		d	h
June	19	8	June	26	1	July	3	8	July	11	10
July	18	17	July	25	7	Aug.	1	21	Aug.	10	1
Aug.	17	00	Aug.	23	15	Aug.	31	12	Sept.	8	14
Sept.	15	7	Sept.	22	2	Sept.	30	5	Oct.	8	1
Oct.	14	16	Oct.	21	18	Oct.	29	22	Nov.	6	10
Nov.	13	2	Nov	20	21	Nov.	28	15	Dec.	5	18
Dec.	12	15	Dec.	20	10	Dec.	28	6	Jan.	4	2

### MERCURY

Makes a brief visit to the evening sky for a few days around June 30 but will be low in the north-west and hard to see. Can be seen in the evening for a week around October 26, setting slightly north of west. On October 29, Mercury will set at 2100 hours. This planet will appear in the morning sky early in December, but will not rise until after dawn and will therefore be hard to find.

### VENUS

Until early September Venus will be in the morning sky, but only until the end of July will it be visible before dawn. During that month it will be a brilliant object. In mid November it will be first noticed in the evening and it will steadily draw away from the Sun for the rest of the year.

At 5 a.m. on August 8 Venus and Jupiter will appear so close together that they will appear as a very bright double star.

### MARS

Not until November will Mars draw away from the Sun and be visible before dawn. It will rise at 2 a.m. on November 27 and shortly before 1 a.m. a month later.

### JUPITER

Jupiter commences to appear in the morning sky before dawn from August 19. It then draws rapidly away from the

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Sun, so that on October 1, it will rise around 3 a.m. and on November 1, at 1.30 a.m. By the end of the year it is rising around 9.30 p.m. and will be visible all night.

At 3 p.m. on September 11, Jupiter will be five degrees south of the Moon and it may be possible to see the planet as a star like point during mid afternoon.

## SATURN

Saturn will be the only bright planet visible in the midnight sky till the end of September. It reaches opposition in mid September and will then rise at sunset and set at sunrise. It remains well placed for most of the year.

## ECLIPSES

On October 29, there will be an eclipse of the Moon visible from New Zealand. However this will be a penumbral eclipse, when the Moon does not enter the umbra, or true shadow of the earth. As a result this eclipse will pass unnoticed even by astronomers.

A total Solar Eclipse occurs on November 12 but cannot be seen from New Zealand. The path of totality crosses South America.

## METEOR SHOWERS

The dates of the most prominent meteor showers visible from New Zealand each year are listed below. For each shower is given a brief description of the type of meteor usually resulting from the display concerned.

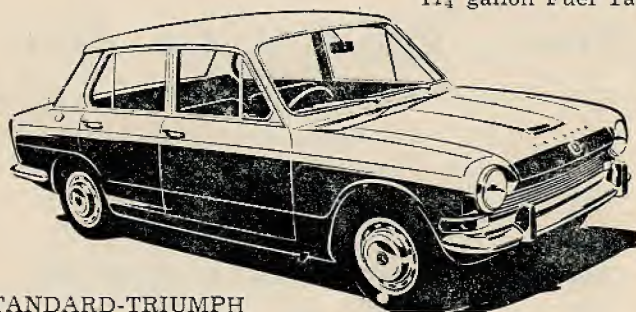
Name	Date of Maximum		Type of Meteor
Aquarids	May	6	Very swift; short paths.
Scorpiids	June	27-30	Very slow: long paths. Often produces fireballs of red or green colour.
Cap-cornids	July	18-30	Very slow and bright.
Aquarids	July	25-30	Slow; long paths.
Orionids	Oct.	18-20	Very swift streaks often with trains.
Leonids	Nov.	13-15	Could possibly give a brilliant display in the early morning in 1966. This shower is at its best every 33 years.

The names for these showers are derived from the constellations from which the meteors appear to radiate.

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# Astronomical Phenomena

## For 1967

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### PHASES OF THE MOON

New Moon		First Quarter		Full Moon		Last Quarter	
	d h		d h		d h		d h
Jan.	11 6	Jan.	19 8	Jan.	26 18	Feb.	2 11
Feb.	9 22	Feb.	18 4	Feb.	25 6	Mar.	3 21
Mar.	11 16	Mar.	19 21	Mar.	26 15	Apl.	2 9
Apl.	10 10	Apl.	18 9	Apl.	25 0	May	1 23
May	10 3	May	17 17	May	24 8	May	31 14
June	8 17	June	15 23	June	22 17	June	30 7
July	8 5	July	15 4	July	22 3	July	30 0
Aug.	6 15	Aug.	13 9	Aug.	20 14	Aug.	28 18
Sept.	5 0	Sept.	11 15	Sept.	19 5	Sept.	27 10
Oct.	4 8	Oct.	11 0	Oct.	18 22	Oct.	27 0
Nov.	2 18	Nov.	9 13	Nov.	17 17	Nov.	25 12
Dec.	2 4	Dec.	9 6	Dec.	17 11	Dec.	24 23

### MERCURY

This planet will be briefly visible in the evening sky in mid February, mid June and early October. The first fortnight in October will be the best time for watchers in New Zealand to see it in the evening sky. Mercury will appear in the morning sky at the end of March, the end of July and in mid-November. Around March 31 will be the best time to see Mercury in the mornings.

### VENUS

For the first half of the year, Venus will be a brilliant sight in the evening sky. It will be furthest from the Sun on June 21, when the planet will be seen in the north west for some time after sunset. A month later it will attain its greatest brilliancy.

By September Venus will be visible in the mornings, where it will be brightest on October 6 and furthest from the Sun on November 10.

Good times to watch Venus are: On the evening of April 13, when Venus and the three day old Moon will lie close together.

On July 8 at 5 p.m. when the planet and the bright star Regulus will appear extremely close together. At noon on July 11 when it should be possible to see Venus in daylight, five degrees south of the Moon.

## MARS

Mars is moving rapidly southwards in the sky until mid October when it commences to move north again. As a result in 1967 it will be more favourably placed for New Zealand observers than in the previous year. The planet reaches opposition on April 16 and will be well seen then throughout the night. It will pass very close to the bright star Spica, in the constellation Virgo, on several occasions. The best dates to see the two objects together are: April 23 at 7 p.m.; July 3 at 7 p.m.; whilst at 7 p.m. on September 23, Mars will pass close to Antares, the bright red star in Scorpius. At 8 p.m. on August 12 Mars will be less than half a degree from the Moon.

## JUPITER

At the beginning of the year, Jupiter will be visible all night and reaches opposition on January 20. But throughout the year it will cross our sky from north east to north west and being well north of the celestial equator will not reach a very high altitude. Jupiter will become too close to the Sun at the beginning of August and will reappear in the morning sky from mid October onwards.

## SATURN

Saturn will be visible low in the north west for a brief time after sunset in January and February. It then passes too close to the Sun to be seen until it reappears in the morning sky in May. From then onwards it draws away from the Sun to reach opposition on October 3. For the remainder of the year it will be visible in the midnight sky.

At 5 a.m. on June 3 Saturn will be occulted by the Moon, which will pass in front of the planet. The planet will be very close to the Moon at 2 a.m. on July 28 and at 10 p.m. on December 10.

## ECLIPSES

In 1967 there will be two eclipses of the Sun, both invisible from New Zealand, and two total eclipses of the Moon. Both the latter will be visible from New Zealand. The first occurs on the night of April 24-25 and the second on the night of October 18-19.

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# The Friends of the Mount John University Observatory Society Incorporated

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Steps are being taken to form an incorporated Society for the dual purpose of assisting the Mount John University Observatory, and to bring together people interested in astronomy. Branches will operate in most of the cities and towns of the surrounding districts.

To adequately make known to the public the functions and work of the Observatory it is desirable that facilities be available on the mountain. Since the Observatory was formally opened on 10th July, 1965, a total of 893 people have visited the Observatory. These visitors have been given a tour of the various buildings and learnt something of astronomy in general and the work of the observatory in particular. But there are no facilities where lectures can be held in comfort, or where photographs, slides and films can be viewed. One of the objects of the Society is to provide these facilities, which cannot be secured from other sources.

Through the Society it is hoped to encourage and foster public interest in the Observatory. The astronomers have no desire to set themselves apart in splendid isolation. They feel that it is part of their duties to explain to the public the wonders of the heavens so that there can be a better general appreciation of astronomy. In doing this they feel that they can make a worth while contribution to the value of the Observatory to the district in which it is situated.

Many people visiting the Observatory have expressed a desire to learn more about the simple facts of astronomy. The Society will enable them to do so through lectures, meetings and by association with people of similar interests.

The Society will be able to stimulate assistance, both financial and by way of free service, to the Observatory thus aiding the Universities concerned in building it to an institution which will be able to take full advantage of New Zealand's unique geographical position to further astronomical research and education.

Should any reader wish to learn more about the Society he is invited to contact the Astronomer in Charge, who will gladly supply information about the Society.

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# An Appeal

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Recently the National Committee for Astronomy in New Zealand presented a report to the Royal Society making various recommendations for the development of Astronomy in this country. This exhaustive review, if implemented will have far reaching effects on the scientific facilities at Mount John. The report is at present under consideration by the Council of the Royal Society of New Zealand.

However, there are certain facilities which the Observatory cannot expect to secure either from the Universities operating the Observatory or from other agencies. Firstly comes the provision of the public lecture hall together with the necessary toilet facilities, water supply, projection apparatus, display and exhibit facilities and offices. The estimated cost is £18,000. Since the erection of such facilities would benefit only the district in which the Observatory is situated and the visitors to that district, funds cannot be expected from Government sources. The Universities of Pennsylvania and Canterbury are unable to make finance available since their money must be devoted to education and research.

Secondly, the University of Pennsylvania have available a refracting telescope of 18-inch aperture. A most useful and valuable instrument. They have borne the cost of renovating this instrument for use in New Zealand and for shipping it here. In addition they have undertaken never to remove it from New Zealand should they ever withdraw from the joint operation. To mount and house the instrument requires a sum of £10,000, thus bringing the total amount needed to £28,000. This figure can be reduced considerably by the many offers of voluntary labour that have been received.

The production of this booklet is one of many ways in which the Observatory is seeking to help itself. Your assistance in purchasing a booklet and in getting your friends also to buy one, will be greatly appreciated since all receipts from this source go to the building fund.

Anyone who cares to assist this building project by making a donation, large or small, is invited to do so and will certainly be helping build a scientific institution of which the district of South Canterbury, in particular, and New Zealand in general will be proud. The Astronomer in Charge is authorised to accept such donations and will give an official receipt.

# HOW BIG?      HOW FAR?

## THE MAJOR PLANETS

Name	Mean distance from Sun		Equatorial Diameter	Mass Earth=1	Density Water=1
	miles	astr. units			
MERCURY	35,980,000	0.39	3,100	0.05	5.2
VENUS	67,240,000	0.72	7,600	0.82	5.1
EARTH	92,956,000	1.00	7,917	1.00	5.52
MARS	141,640,000	1.52	4,200	0.11	4.0
JUPITER	483,580,000	5.20	88,700	317.8	1.33
SATURN	888,770,000	9.56	75,100	95.2	0.68
URANUS	1,782,300,000	19.17	29,000	14.5	1.7
NEPTUNE	2,784,300,000	29.95	28,000	17.2	2.2
PLUTO	3,662,000,000	39.39	3,600?	0.8?	?

The relative distances of the planets from the Sun are known with great accuracy. These distances are given under the column headed astronomical units. One astronomical unit is equal to the mean distance between the Sun and the Earth. However, the distances in absolute units, i.e., the miles shown in column 2 above are not so accurately known.

## THE SATELLITES OF THE SOLAR SYSTEM

Whilst the Earth has one the Moon as a companion, Mars has two satellites; Jupiter 12; Saturn 9; Uranus 5; Neptune 2, whilst Mercury, Venus and Pluto have no satellites. Many of these are very small bodies. Those of Mars for instance are thought to have diameters of 5 and 3 miles. The following table lists the seven largest which are those whose diameter exceeds 1,000 miles.

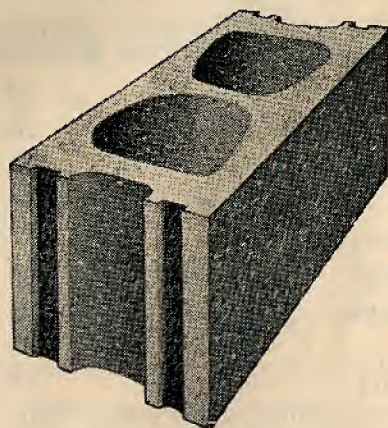
## THE SEVEN LARGEST SATELLITES OF THE SOLAR SYSTEM

Planet	Satellite	Distance from Planet	Diameter	Mass Moon=1
Jupiter	111 Ganymede	665,000	3,120	2.1
Saturn	Titan	759,000	2,980	1.9
Jupiter	IV Callisto	1,171,000	2,770	1.3
Neptune	Triton	220,000	2,300	1.9
Earth	Moon	238,900	2,160	1.0
Jupiter	1 Io	262,000	2,020	1.0
Jupiter	11 Europa	417,000	1,790	0.6

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# THE TWENTY BRIGHTEST STARS

Name	Visual Magnitude		Distance Light years	Visual Luminosity Sun = 1	
	A	B		A	B
Alpha Canis Maj. (Sirius)	-1.42	+8.7	8.7	20	0.002
Alpha Carinae (Canopus)	-0.72		100	1300	
Alpha Centauri	+0.01	1.4	4.3	1.3	0.36
Alpha Bootis (Arcturus)	-0.06		36	100	
Alpha Lyrae (Vega)	+0.04		26	50	
Alpha Aurigae (Capella)	+0.05	10.2	45	75	60
Beta Orionis (Rigel)	+0.14	6.6	900	50000	100
Alpha Canis Mi. (Procyon)	+0.37	10.7	11.5	6.7	0.001
Alpha Ori. (Betelgeuse)	+0.41var		500	13000	
Alpha Eridani (Achernar)	+0.51		120	600	
Beta Centauri	+0.63	4	500	9000	400
Alpha Aquilae (Altair)	+0.77		16.8	9.8	
Alpha Crucis	+1.39	1.9	400	3000	1700
Alpha Tauri (Aldebaran)	+0.86	13	68	150	0.002
Alpha Virginis (Spica)	+0.91		230	250	
Alpha Scorpii (Antares)	+0.92var		500	8000	170
Beta Geminorum (Pollux)	+1.16		35	30	
Alpha Piscis A. (Fomalhaut)	+1.19	6.5	23	12	0.09
Alpha Cygni (Deneb)	+1.26		1600	50000	
Beta Crucis	+1.28		500	5000	

In the above table the second column shows the apparent visual magnitude which is how bright the star appears to us. When a star has a companion and thus forms a double system the apparent brightness of the companion is also shown but under "B". It will be noticed that whilst these 20 stars are those which appear the brightest to us their distances range from 4.3 light years for Alpha Centauri to 1,600 light years for Alpha Cygni. Their luminosities compared to our own Sun range from 50,000 times to 1.3 times for the principal stars and from 1,700 times to 0.001 times the Sun's luminosity for the companions. Two stars, Betelgeuse and Antares, change in brightness.

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